

Remarks

The Office Action mailed October 31, 2007 has been carefully reviewed and the following response has been made in consequence thereof.

Claims 1-20 are now pending in this application. Claims 1-20 stand rejected.

The rejection of Claims 1, 5-7, 9-12, and 17-20 under 35 U.S.C. § 103(a) as being unpatentable over by U.S. Patent 6,526,305 to Mori (hereinafter referred to as "Mori") in view of U.S. Patent 5,969,524 to Pierpaoli (hereinafter referred to as "Pierpaoli") is respectfully traversed.

Mori describes a method of creating an image of brain fibers. The method includes exposing the brain fibers to a magnetic resonance imaging process and acquiring diffusion-weighted images that are employed to calculate an apparent diffusion constant at each pixel along more than six axes. The method also includes introducing data into a microprocessor that calculates six variables in a diffusion tensor and obtains a plurality of eigen values and eigen vectors. In a preferred embodiment, the method also includes the initiation of fiber tracking by selecting a pixel for initiation of the same, connecting the pixels and effecting a judgment regarding termination of the pixel tracking in each direction based upon the randomness of the fiber orientation of the adjacent pixels.

Pierpaoli describes a method for quantitatively assessing diffusion anisotropy according to an invariant anisotropy index. The method accounts for an orientational coherence of measured principal directions between different localized regions of an object to counteract a bias and increased variance effects of noise inherent in the diffusion measurement. The method includes performing a diffusion weighted imaging sequence on a two-dimensional slice of an object to provide raw diffusion weighted image signals. The signals are processed by conventional Fourier transform and magnitude reconstruction to provide diffusion weighted images. A diffusion tensor is estimated from the diffusion weighted images for each voxel of the imaged slice. In each voxel a lattice anisotropy index

is calculated as a function of both the eigenvalues and eigenvectors of neighboring voxels such that intervoxel orientational coherence compensates noise-induced bias effects.

The Examiner asserts that adding simulated noise to the signal intensities, as described in Pierpaoli, is equivalent to defining points obtained by randomly moving grid points, as set forth in the presently claimed invention. Applicants submit that adding noise to the pixel data does not change and/or move the grid points of the pixels. Rather, Applicants submit that adding noise to the pixel data changes the diffusion characteristics of the pixel. More specifically, adding noise to the pixel data changes a direction of a diffusion tensor that is related to diffusion anisotropy of the pixel. Applicants submit that making the diffusion tensor random decreases a performance of fiber tracking and fiber rendering. In contrast, the present invention increases fiber tracking and fiber rendering. Accordingly, Pierpaoli does not describe or suggest a fiber rendering apparatus that includes a device for defining points obtained by randomly moving grid points based on a distribution function.

Claim 1 recites a fiber rendering apparatus comprising “a device for specifying a region of interest or volumetric region of interest in three-dimensional image data collected by a diffusion tensor method in an MRI apparatus...a device for defining regular grid points in the region of interest or volumetric region of interest...a device for defining points obtained by randomly moving the grid points based on a distribution function in a two-dimensional or three-dimensional manner as tracking start points...a device for performing diffusion tensor analysis on each tracking start point in the three-dimensional image data to determine a direction of a principal axis vector...a device for tracking a fiber by repeatedly selecting a neighbor point along the direction of the principal axis vector and performing diffusion tensor analysis on the neighbor point to determine a direction of a principal axis vector...a device for producing and displaying an image of the tracked fibers as viewed in a desired view direction.”

Neither Mori nor Pierpaoli, considered alone or in combination, describe or suggest a fiber rendering apparatus, as is recited in Claim 1. More specifically, neither Mori nor Pierpaoli, considered alone or in combination, describe or suggest a fiber rendering apparatus that includes a device for defining points obtained by randomly moving grid points based on

a distribution function. Rather, Mori merely describes effecting a judgment regarding termination of pixel tracking in each direction based upon a randomness of a fiber orientation of adjacent pixels, and Pierpaoli describes changing the diffusion characteristics of pixels by adding noise to the pixel data.

Accordingly, for at least the reasons set forth above, Claim 1 is submitted to be patentable over Mori in view of Pierpaoli.

Claims 7 and 9-12 depend from Claim 1. When the recitations of Claims 7 and 9-12 are considered in combination with the recitations of Claim 1, Applicants submit that Claims 7 and 9-12 likewise are patentable over Mori in view of Pierpaoli.

Claim 5 recites a fiber rendering apparatus comprising “a device for defining tracking start points in three-dimensional image data collected by a diffusion tensor method in an MRI apparatus, wherein the tracking start points are generated by randomly displacing a plurality of grid points located in a region of interest based on a distribution function...a device for performing diffusion tensor analysis on each tracking start point in the three-dimensional image data to determine a direction of a principal axis vector and eigenvalues of a diffusion tensor...a device for tracking a fiber by repeatedly selecting a neighbor point along the direction of the principal axis vector and performing diffusion tensor analysis on the neighbor point to determine a direction of a principal axis vector and eigenvalues of a diffusion tensor...a device for producing an image of the tracked fibers as viewed in a desired view direction and displaying the image with display colors reflecting the eigenvalues of the diffusion tensors at the tracking start points and neighbor points.”

Neither Mori nor Pierpaoli, considered alone or in combination, describe or suggest a fiber rendering apparatus as recited in Claim 5. More specifically, neither Mori nor Pierpaoli, considered alone or in combination, describe or suggest a fiber rendering apparatus that includes a device for defining tracking start points in three-dimensional image data collected by a diffusion tensor method in an MRI apparatus, wherein the tracking start points are generated by randomly displacing a plurality of grid points located in a region of interest based on a distribution function. Rather, Mori merely describes effecting a judgment

regarding termination of pixel tracking in each direction based upon a randomness of a fiber orientation of adjacent pixels, and Pierpaoli describes changing the diffusion characteristics of pixels by adding noise to the pixel data.

Accordingly, for at least the reasons set forth above, Claim 5 is submitted to be patentable over Mori in view of Pierpaoli.

Claims 6 and 17-20 depend from Claim 5. When the recitations of Claims 6 and 17-20 are considered in combination with the recitations of Claim 5, Applicants submit that Claims 6 and 17-20 likewise are patentable over Mori in view of Pierpaoli.

For at least the reasons set forth above, Applicants respectfully request that the Section 103 rejection of Claims 1, 5-7, 9-12, and 17-20 be withdrawn.

The rejection of Claims 2-4, 8, and 13-16 under 35 U.S.C. § 103(a) as being unpatentable over Mori and Pierpaoli in view of U.S. Patent Application Publication 2003/0234781 to Laidlaw et al. (hereinafter referred to as “Laidlaw”) is respectfully traversed.

Mori and Pierpaoli are described above. Laidlaw describes a system for rendering volumetric multivalued primary data. The system includes a rendering engine having an input coupled to a source of multivalued primary data and an output coupled to a display. The rendering engine includes a data processor for calculating additional data values from the primary data, deriving at least one visual representation from the primary data and the additional data values, and mapping the derived visual representation through transfer functions to hardware primitives for volumetrically rendering the derived visual representation to provide a visualization. The system also includes a user interface for interacting with the visualization. Notably, Laidlaw does not describe or suggest a device for defining tracking start points in three-dimensional image data collected by a diffusion tensor method in an MRI apparatus, wherein the tracking start points are generated by randomly displacing a plurality of grid points located in a region of interest based on a distribution function. Rather, Laidlaw is merely cited for displaying an image with opacity values that reflect diffusion anisotropy values. Applicants submit that merely describing displaying an

image with opacity values that reflect diffusion anisotropy values does not describe or suggest randomly displacing grid points based on a distribution function.

Claim 2 recites a fiber rendering apparatus comprising “a device for defining tracking start points in three-dimensional image data collected by a diffusion tensor method in an MRI apparatus, wherein the tracking start points are generated by randomly displacing a plurality of grid points located in a region of interest based on a distribution function...a device for performing diffusion tensor analysis on each tracking start point in the three-dimensional image data to determine a direction of a principal axis vector and a diffusion anisotropy value...a device for tracking a fiber by repeatedly selecting a neighbor point along the direction of the principal axis vector and performing diffusion tensor analysis on the neighbor point to determine a direction of a principal axis vector and a diffusion anisotropy value...a device for producing an image of the tracked fibers as viewed in a desired view direction and displaying the image with opacity reflecting the diffusion anisotropy values at the tracking start points and neighbor points.”

None of Mori, Pierpaoli, and Laidlaw, considered alone or in combination, describes or suggests a fiber rendering apparatus as recited in Claim 2. More specifically, none of Mori, Pierpaoli, and Laidlaw, considered alone or in combination, describes or suggests a fiber rendering apparatus that includes a device for defining tracking start points in three-dimensional image data collected by a diffusion tensor method in an MRI apparatus, wherein the tracking start points are generated by randomly displacing a plurality of grid points located in a region of interest based on a distribution function. Rather, Mori merely describes effecting a judgment regarding termination of pixel tracking in each direction based upon a randomness of a fiber orientation of adjacent pixels, Pierpaoli describes changing the diffusion characteristics of pixels by adding noise to the pixel data, and Laidlaw merely describes displaying an image with opacity values that reflect diffusion anisotropy values.

Accordingly, for at least the reasons set forth above, Claim 2 is submitted to be patentable over Mori and Pierpaoli in view of Laidlaw.

Claims 3, 4, 13-16 depend from Claim 2. When the recitations of Claims 3, 4, 13-16 are considered in combination with the recitations of Claim 2, Applicants submit that Claims 3, 4, 13-16 likewise are patentable over Mori and Pierpaoli in view of Laidlaw.

Claim 8 depends from Claim 1, which is recited above.

None of Mori, Pierpaoli, and Laidlaw, considered alone or in combination, describes or suggests a fiber rendering apparatus, as is recited in Claim 1. More specifically, none of Mori, Pierpaoli, and Laidlaw, considered alone or in combination, describes or suggests a fiber rendering apparatus that includes a device for defining points obtained by randomly moving grid points based on a distribution function. Rather, Mori merely describes effecting a judgment regarding termination of pixel tracking in each direction based upon a randomness of a fiber orientation of adjacent pixels, Pierpaoli describes changing the diffusion characteristics of pixels by adding noise to the pixel data, and Laidlaw merely describes displaying an image with opacity values that reflect diffusion anisotropy values.

Accordingly, for at least the reasons set forth above, Claim 1 is submitted to be patentable over Mori and Pierpaoli in view of Laidlaw.

Claim 8 depends from Claim 1. When the recitations of Claim 8 are considered in combination with the recitations of Claim 1, Applicants submit that Claim 8 likewise is patentable over Mori and Pierpaoli in view of Laidlaw.

For at least the reasons set forth above, Applicants respectfully request that the Section 103 rejection of Claims 2-4, 8, and 13-16 be withdrawn.

In view of the foregoing remarks, all the claims now active in this application are believed to be in condition for allowance. Reconsideration and favorable action is respectfully solicited.

Respectfully Submitted,



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